



NU DASMARIÑAS

GESTS01X – Science, Technology and Society

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Week 6 - The Nature of Science and Controversies



Learning Outcomes

1. Understand the nature of Science
2. Evaluate the different Science controversies



What do Scientists Assume?

- The physical world is understandable.
- Science cannot provide the answers to all questions.
- Scientific knowledge is durable, but it does not represent absolute truth.
- Scientific ideas are tentative (or subject to change).



Science as a Way of Knowing

Science vs Other Ways of Knowing

Science is based on empirical research.

- Empirical research relies on systematic observation and experimentation, not on opinions and feelings.

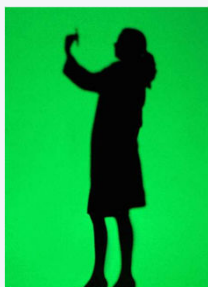
Systematic observations and experiments provide research results that must meet two criteria in order for a scientist's research to withstand thorough questioning.

- **Validity** means that research is relevant to the question being asked.
- **Reliability** describes the repeatability or consistency of the research.



How do Scientist decide what to Study?

Work of Scientist vs Detectives



Scientists ...	Detectives ...
ask questions to discover new information about natural phenomena.	conduct inquiries (or ask questions) to discover what happened.
make observations through scientific inquiry.	make observations through surveillance.
propose hypotheses based on prior knowledge.	propose likely scenarios based on experience.
collect, analyze, and interpret data (evidence).	(with help from forensic scientists) collect, analyze, and interpret evidence.
construct explanations, using evidence and reasoning to justify these explanations.	construct likely scenarios, using evidence and reasoning to infer or deduce what happened.
evaluate or critique other scientists' explanations.	evaluate alternative scenarios to exclude all other possibilities and suspects.
communicate their research methods and findings to other scientists and the public.	present evidence to prosecutors and the courts.





Why Do Scientists Argue and Challenge Each Other's Results?

- By using empirical methods, scientists are able to reexamine evidence and data, repeat experiments, replicate research results, and confirm (or reject) explanations.
- Scientists want other scientists in the same field of study to review their methods and challenge their results because the public and the scientific community will have confidence in their explanations only after other qualified scientists have judged their work to be valid.

Scientific Argument

- A **scientific argument** is defined as people disagreeing about scientific explanations (claims) using empirical data (evidence) to justify their side of the argument.
- Scientists identify weaknesses and limitations in others' arguments, with the ultimate goal of refining and improving scientific explanations and experimental designs. This process is known as **evidence-based argumentation**.

Claim		Evidence		Rationale
An explanation or an answer to a research question that	is supported by	Observations that show trends over time or relationships between variables	and is justified by	Reasoning that explains the evidence and why it supports the claim.
Adapted from Sampson, Grooms, and Walker, 2011				



Why Must Scientists Be Skeptics?

- Being skeptical allows scientists to consider all possibilities and systematically question all information in the course of an investigation.
- Skepticism helps scientists to remain objective when performing scientific inquiry and research. It forces them to examine claims (their own and those of others) to be certain that there is sufficient evidence to back them up.
- *Skeptics do not doubt every claim, only those backed by insufficient evidence or by data that have been improperly collected, are not relevant, or cannot support the rationale being made.*



Difference between Skepticism & Denial

- Skepticism allows scientists to reach logical conclusions supported by evidence that has been examined and confirmed by others in the same field, even when that evidence does not confirm absolute certainty.
- Denial is the act of clinging to an idea or belief despite the presence of overwhelming evidence to the contrary.

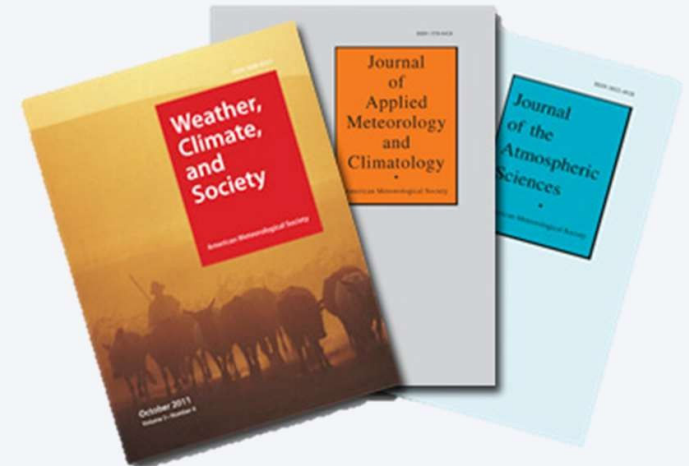
“Skepticism is healthy both in science and society; denial is not.”

(Washington & Cook, 2011, p.2)



How Do Scientists Collaborate and Reach Consensus?

- Reviewing and questioning scientists' methods, data, and findings, allows scientists not only improve their work, but also to communicate more effectively.
- The **peer-review process** serves as a quality-control check before scientific research is published.



The Scientific Peer Review Process

1. Scientists submit their research in the form of an article (or paper) to a scientific journal.
2. Scientists in related fields (peers) read and evaluate the submitted article. They recommend changes to the author(s) that would improve the article or research.
3. The scientists make the recommended changes or explain why they did not.
4. Once papers are presented at conferences or are published, the wider scientific community has an opportunity to review and challenge the research.



How Are Scientific Theories Developed?

A **scientific theory** is the end product drawn from comprehensive research, which combines all the most current, valid evidence to explain a wide range of phenomena (scientific observations). A scientific theory represents the most powerful explanation that scientists have to offer.

Is It a Law or a Theory?

Scientific laws *describe* specific relationships under given conditions in nature, but they do not explain those relationships. Sir Isaac Newton's third law of motion — For every action, there is an equal and opposite reaction — is a good example. Thus, laws are well-supported descriptions, whereas theories are well-supported explanations. One important point to remember is that theories do not become laws, and laws do not become theories.

How Certain Is Science?

- The pursuit of science focuses on establishing probability rather than certainty. Scientists accept the fact that they are not all knowing and must remain objective and open to other possibilities when conducting scientific research.
- Through the use of consensus-building activities — challenging others' ideas, reexamining and retesting data, critiquing others' work through the peer-review process — scientists have been able to build a body of knowledge about which we can be reasonably confident.



Science Controversies

A **scientific controversy** is a substantial disagreement among scientists. A scientific controversy may involve issues such as the interpretation of data, which ideas are most supported by evidence, and which ideas are most worth pursuing.

A **scientific controversy** can be defined as a persistent disagreement over scientific knowledge. This can include the content of the knowledge, for example claims about facts and theories. It can also include scientific method, namely how research is carried out.



The globalization of scientific and technological controversy examine the following possibilities:

The existence of controversy

Prominence

Options

Arguments

Evidence

Participation

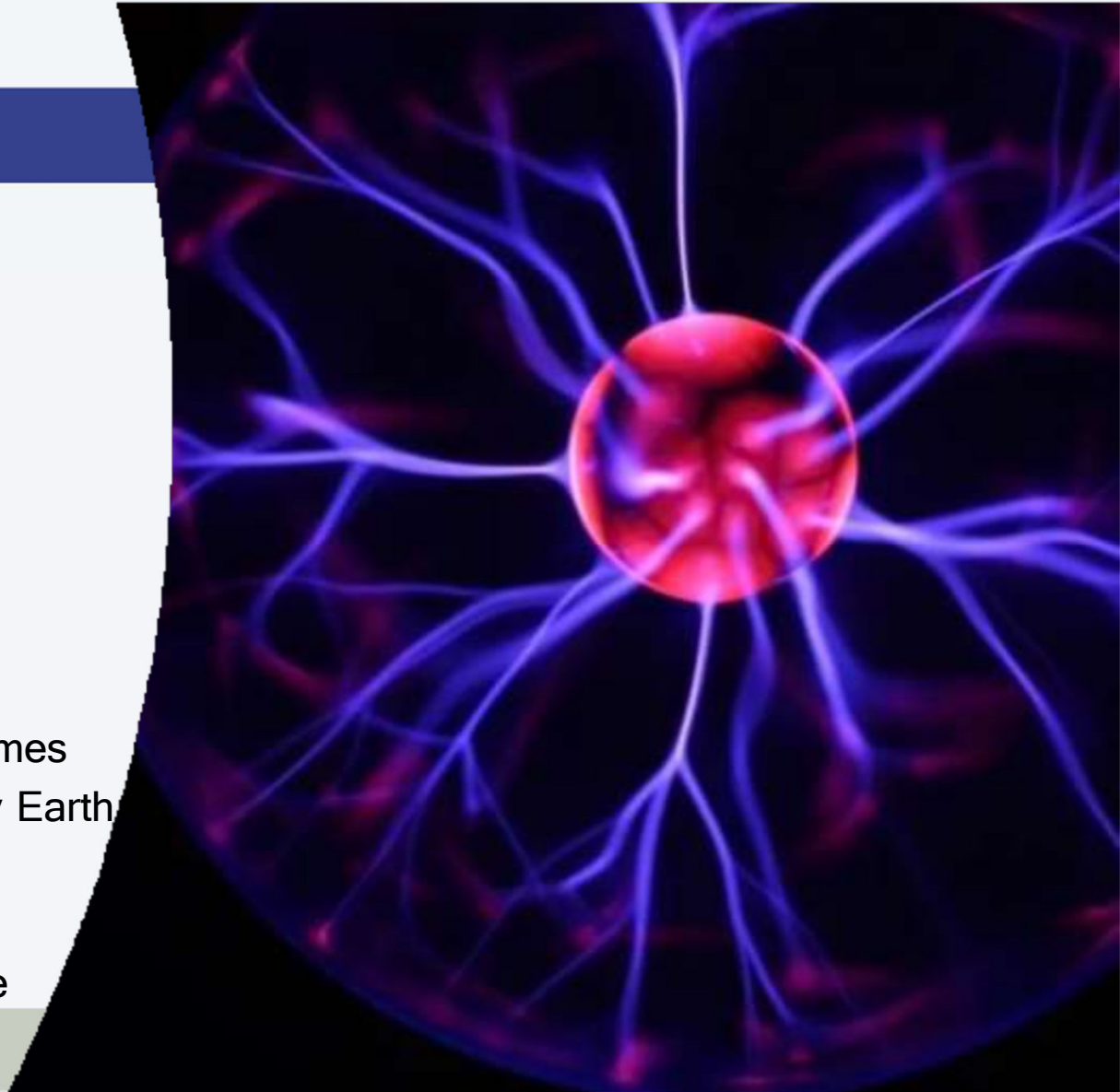
Methods of struggle

Decision-making methods

Outcomes

10 Examples of Settled Science that are “Controversial”

- Evolution
- Animal Testing Is Necessary
- Embryonic Stem Cell Research Is Necessary
- Vaccines Don't Cause Autism
- Alternative Medicine Is Bunk Sometimes
- Large Hadron Collider Won't Destroy Earth
- Cold Fusion Isn't Real
- Nuclear Power Is Safe Consider this
- Climate Change Is Largely Manmade
- GMOs Are Safe





1

Conflicts over the beliefs, values, and interests of individuals and organizations, rather than simply a need for scientific knowledge, are central to the debate.

2

The public perceives uncertainty either in the science or its implications or as a result of communicators making different and sometimes contradictory statements in the public sphere.

3

The voices of organized interests and influential individuals are amplified in public discourse, making it difficult for the state of the scientific evidence to become clearly known.

Three Features of Science Related Controversies

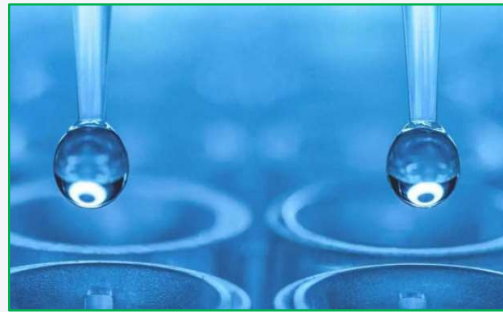
Abortion



Blood Transfusion



Cloning

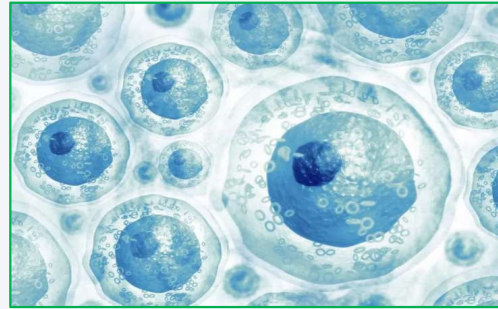


Some of the Controversial Issues



COVID-19 pandemic

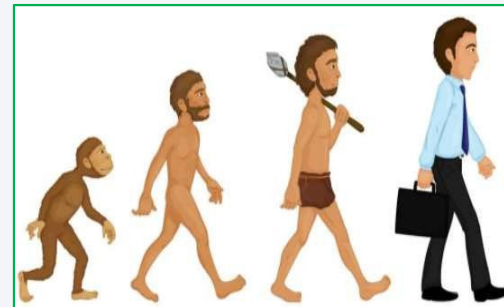
Stem Cells



Human Evolution



Modern Flat Earth Societies



Some of the Controversial Issues



Other Controversial Issues

Abortion
AIDS
Alcoholism
Allopathic medicine
Alternative medicine and closely related issues
Answers in Genesis (AiG)
Assisted suicide
Aspartame controversy
Astrology as a "science"
Bioethics

ADD/ADHD
AIDS denialism
Allergy - causes of.
Alzheimer's disease
Anencephaly
Anthropology
Aspartame
Asperger's syndrome and Autism
Bates method
Biology and sexual orientation



Other Controversial Issues

Birth defect
Blood transfusions
Cancer cures
Chakra
Chromosome
Cloning
Cold fusion
COVID-19 pandemic
Creation science
Depression

Black hole information paradox
Breast cancer
Caesarean section
Chiropractic
Circumcision
Cochlear implant
Conjoined twins
Cryonics
Depleted uranium
Disability



Other Controversial Issues

Drugs

Ebola virus

Electrical sensitivity

Eugenics

Evolution

Family planning

Flat Earth Society

Dyslexia

Albert Einstein

Elitism

Euthanasia

Extraterrestrial Life

Female genital mutilation

Genetic engineering



REFERENCES & SUPPLEMENTAL RESOURCES

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